REMARKS

The Office Action mailed March 18, 2004, has been carefully reviewed and Applicants note with appreciation the identification of allowable subject matter.

By this Amendment, Applicants have canceled claims 95, 111, 112, 114, 115, 138, 139, and 142-151, amended claims 83, 96, 97, 113, 117, 140, and 141, and added new claims 152-165. Claims 83, 86-94, 96, 97, 99, 101-109, 113, 116, 117, 119-124, 126, 128-136, 140, 141 and 152-165 are pending in the application.

The Examiner rejected claims 94-97 and 140 under 35 U.S.C. 112, second paragraph, as being indefinite. By this Amendment, Applicants have corrected the informalities noted and the amended claims are in conformity with 35 U.S.C. 112, second paragraph.

The Examiner rejected claims 83, 86, 99, 101-103, 106, 108, 109, 111-117, 119-121, 126, 128-130, 133, 135, 136, 138-147, 149 and 150 under 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 6,108,369 to Ovesjo et al. ("Ovesjo"). The Examiner also rejected claims 107, 134, 148 and 151 under 35 U.S.C. 103(a) as being unpatentable over Ovesjo in view of U.S. Patent Application No. 2003/0147655 to Shattil. The Examiner objected to claims 87-93, 104, 105, 122-124, 131 and 132 as being dependent on a rejected base claim but stated that these claims would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims.

Ovesjo discloses channelization code allocation for radio communication systems so that the control channel is orthogonal to all physical channels in the composite spread spectrum

signal. However, Ovesjo does not disclose or even suggest that selection of the spreading codes of the two consecutive pairs of I data and Q data are correspondent to two points located on the same point or symmetrical with respect to a zero point (origin) on a phase domain. In addition, Ovesjo fails to teach that a certain spreading code is allocated to a predetermined channel.

The subject matter of the present invention, in particular the order of allocating the spreading codes, is obtained through a lot of simulation. The simulation result is clearly disclosed in the attached article entitled, "Channelization Code Allocation in Uplink Multi-Code Transmissions", TSG-RAN Working Group 1 meeting #6, Espoo, Finland, July 13-16, 1999. The article was contributed to the 3GPP *by the Applicant of the present invention* (less than one year before the filing of this application) and was selected as the Standard, a copy of which is also attached (3GTS 25.213 V5.4.0, sections 4.3.1.2 and 4.3.1.3).

Referring to page 1 of the article, in the case that two DPDCHs are spread by a single OVSF code, when both DPDCHs are spread by the same code $C_{4,2}$ (which is the same as $C_{4,1}$ in the specification because the spreading codes are represented by $C_{4,0}$ to $C_{4,3}$ in the specification and $C_{4,1}$ to $C_{4,4}$ in the article), the performance improvement is significant as compared with the other cases.

Referring to page 3 of the article, in the case that the spreading factor is 4, the best channelization code allocation in uplink is to spread with the same code $C_{4,2}$ in case of two DPDCHs, and for three for four DPDCHs, the best way is to spread the $DPDCH_3$ and $DPDCH_4$ by code $C_{4,4}$. This is clearly not

shown or suggested by Ovesjo and, therefore, claims 83, 113, 117 and 141 are patentable over the prior art.

Claims 86-94, 96, 97, 99, 101-109, 116, 119-124, 126, 128-136, and 140 are also in condition for allowance as claims properly dependent on an allowable base claim and for the subject matter contained therein. Favorable reconsideration is requested.

New claim 152 represents the subject matter of claim 87 rewritten in independent form to include the limitations of underlying claims 83 and 86 and is therefore in condition for allowance in accordance with the Examiner's identification of allowable subject matter. Claims 153-158 correspond with original claims 88-93 and are also in condition for allowance in accordance with the Examiner's identification of allowable subject matter and as claims properly dependent on an allowable base claim.

New claim 159 represents the subject matter of claim 104 rewritten in independent form to include the limitations of underlying claims 83, 102 and 103, and is therefore in condition for allowance in accordance with the Examiner's identification of allowable subject matter. Claim 160 corresponds with original claim 105 and is also in condition for allowance in accordance with the Examiner's identification of allowable subject matter and as a claim properly dependent on an allowable base claim.

New claim 161 represents the subject matter of claim 122 rewritten in independent form to include the limitations of underlying claims 117, 199 and 120, and is therefore in condition for allowance in accordance with the Examiner's identification of allowable subject matter. Claims 162 and 163 correspond with original claims 123 and 124 and are also in

condition for allowance in accordance with the Examiner's identification of allowable subject matter and as claims properly dependent on an allowable base claim.

New claim 164 represents the subject matter of claim 131 rewritten in independent form to include the limitations of underlying claims 117, 119, 120, 121, 129, and 130 and is therefore in condition for allowance in accordance with the Examiner's identification of allowable subject matter. Claim 165 corresponds with original claim 132 and is also in condition for allowance in accordance with the Examiner's identification of allowable subject matter and as a claim properly dependent on an allowable base claim.

With the foregoing amendments and remarks, the application is in condition for allowance. Should the Examiner have any questions or comments, the Examiner is cordially invited to telephone the undersigned attorney so that the present application can receive an early Notice of Allowance.

Respectfully submitted,

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TSG-RAN Working Group 1 meeting #6
Espoo, Finland
July 13-16, 1999

TSGR1#6(99)828

Agenda item:
Source: ETRI
Title: Channelization code allocation in uplink multi-code transmissions
Document for: Decision

1 Introduction

At the last meeting in Cheju, it was agreed that the uplink multi-code transmission for high data rate is only applied for a spreading factor of 4. But, there was remained the detail method for channelization code allocation of DPDCH, when multicode transmission is applied.
This contribution proposes the method of channelization code allocation for more than one DPDCH.

2 Proposal

In [1], dedicated physical channels are spread by OVSF code $C_{SF,\,code\ number}$. Therefore, DPCCH is spread by OVSF code $C_{256,1}$ and DPDCH is spread by OVSF code $C_{SF,\,code\ number}$. For DPDCH, Ericsson proposed the method of channlization code, when multicode transmission is applied[2]. The concept is as follows:

- When one DPDCH is to be transmitted, $DPDCH_1$ is spread by the OVSF code $C_{4,2}$.
- When more than one DPDCH is to be transmitted, $DPDCH_n$ is spread by the code $C_{4,k}$, where $k = 2$ if $n \in \{1, 2\}$, $k = 3$ if $n \in \{3, 4\}$, and $k = 4$ if $n \in \{5, 6\}$.

We agreed the basic concept that the same OVSF code for I and Q is pairwise assigned for $DPDCH_n$. However, we would like to propose different order of k according to our PAPR (peak to average power ratio) simulation results.

Figure 1 and 2 show the case of one DPDCH transmission spread by single OVSF code with high power of the DPDCH. The best thing is still the one spread by code $C_{4,2}$ in this case like the relative low power (e.g. high SF) case of DPDCH.

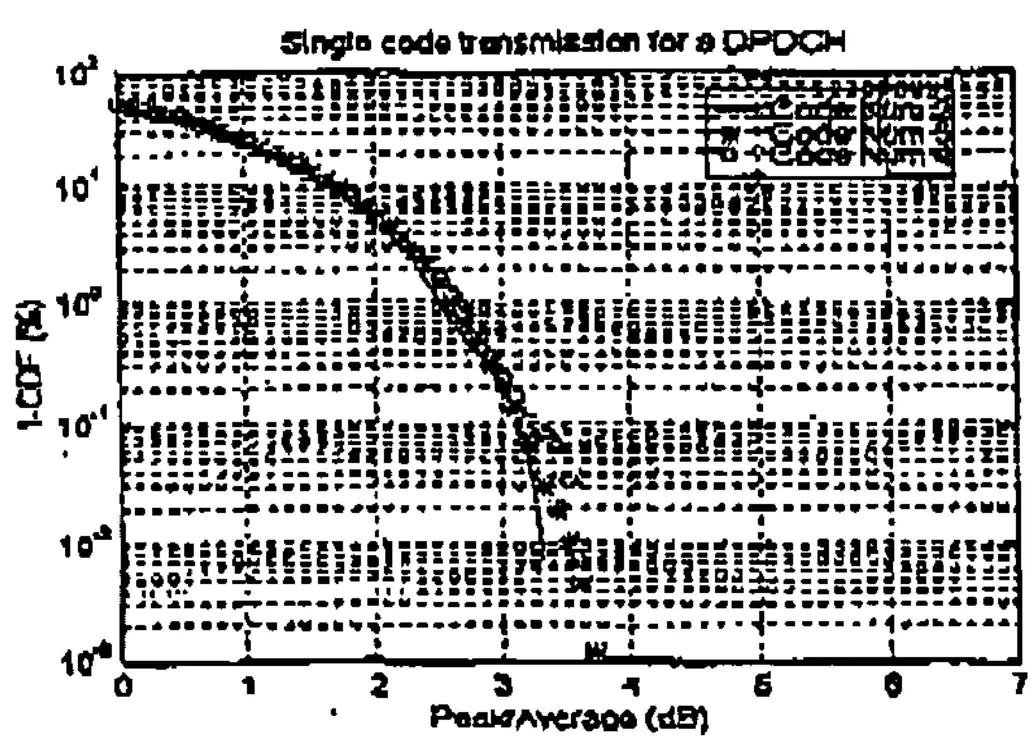

Figure 1. Single Code Transmission for a DPDCH ($DPDCH_1$ = 21dB, DPCCH = 0 dB)

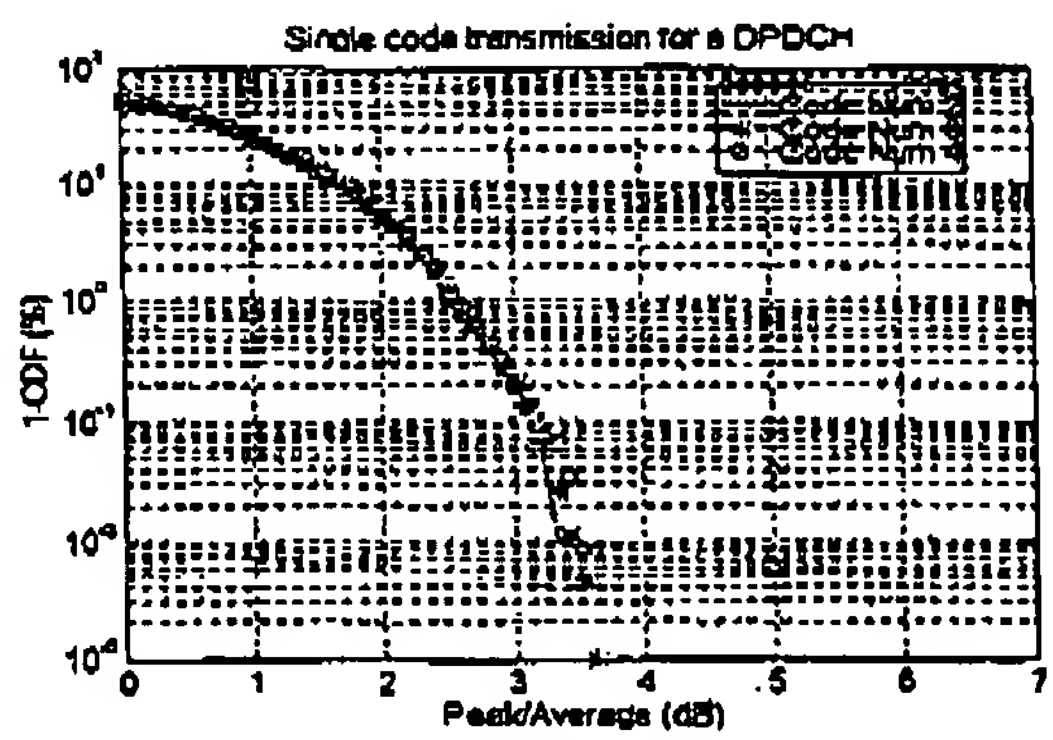

Figure 2. Single Code Transmission for a DPDCH ($DPDCH_1$ = 24dB, DPCCH = 0dB)

Figures 3 to 12 show the PAPR results in multicode transmission case. There are two cases of power setting for DPDCH with DPCCH set to 0dB. One is 21dB and the other 24dB for DPCCH. For multicode transmission, the OVSF code $C_{4,2}$ has to be first allocated before the other codes $C_{4,3}$ and $C_{4,4}$.

In Figure 3 and 4, it is assumed that the 2 DPDCHs are spread by single OVSF code. When both DPDCHs are spread by the same code $C_{4,2}$, the performance improvement is significant than the other cases. In Figure 3 and 4, the '*' marker is the result spread by $C_{4,2}$ and $C_{4,3}$ for $DPDCH_1$ and $DPDCH_2$, respectively. And the 'o' marker is the result spread by $C_{4,2}$ and $C_{4,4}$. At the point of 10^{-1}(1-CDF(%)), the result spread by the same code $C_{4,2}$ is about 2dB better than the one spread by the codes $C_{4,2}$ and $C_{4,3}$ or $C_{4,4}$.

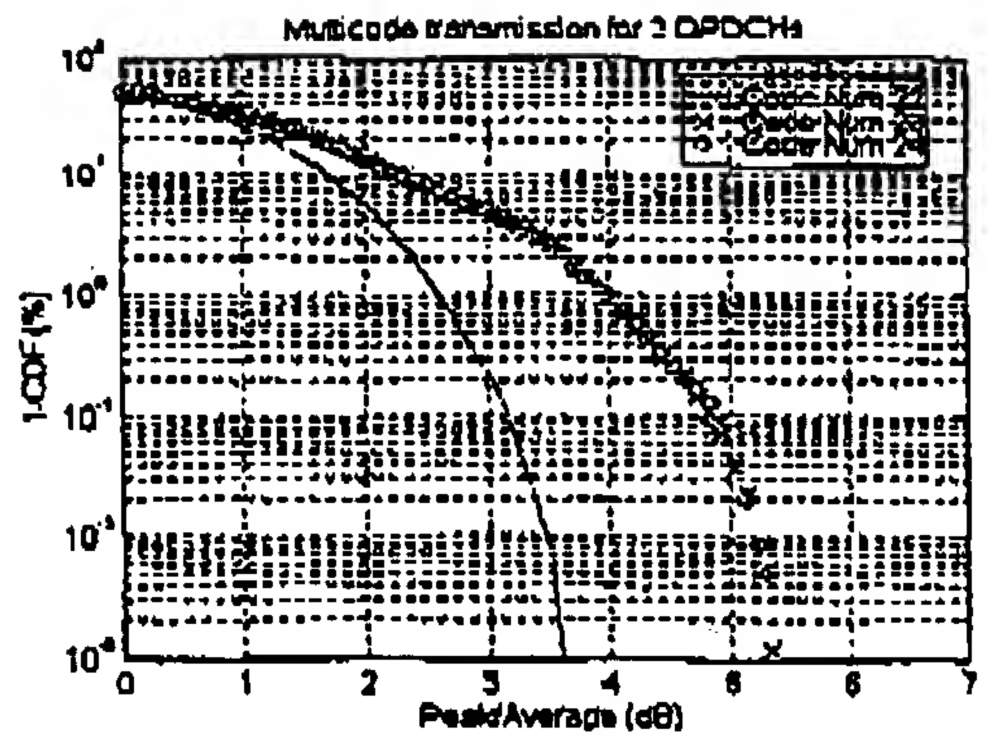

Figure 3. Multicode Transmission for 2 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

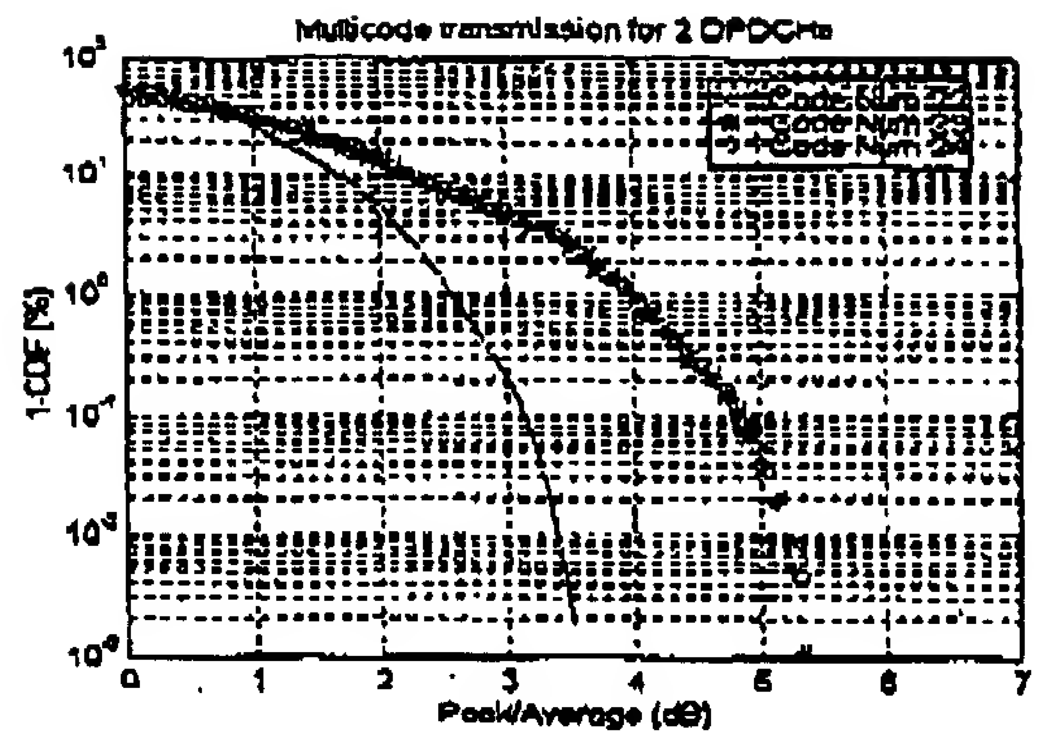

Figure 4. Multicode Transmission for 2 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

Figure 5 and 6 is the cases of 3 DPDCHs. The $C_{4,2}$ is first allocated for $DPDCH_1$ and $DPDCH_2$, and then $DPDCH_3$ is spread by code $C_{4,3}$ or $C_{4,4}$. Figure 7 and 8 is the case of 4 DPDCHs. The $C_{4,2}$ is first allocated for $DPDCH_1$ and $DPDCH_2$, and then $DPDCH_3$ and $DPDCH_4$ are spread by the same code $C_{4,3}$ or $C_{4,4}$. From these Figures, we can find out that OVSF code $C_{4,4}$ is better than the code $C_{4,3}$ as the second code allocation.

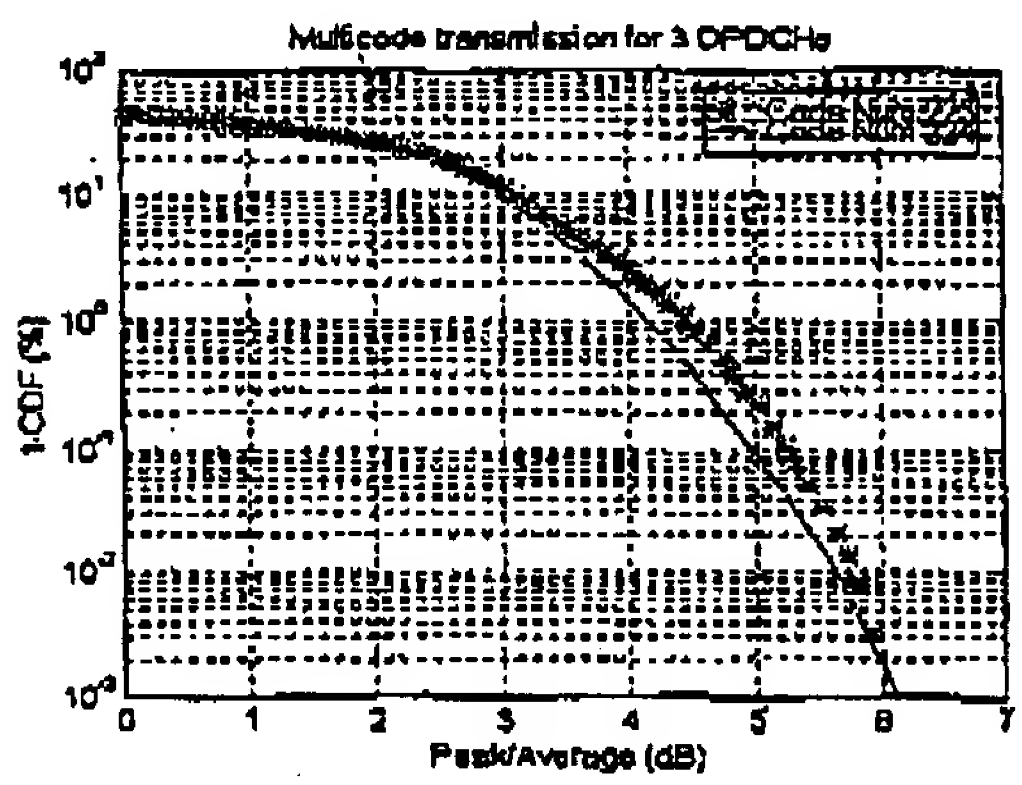

Figure 5. Multicode Transmission for 3 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

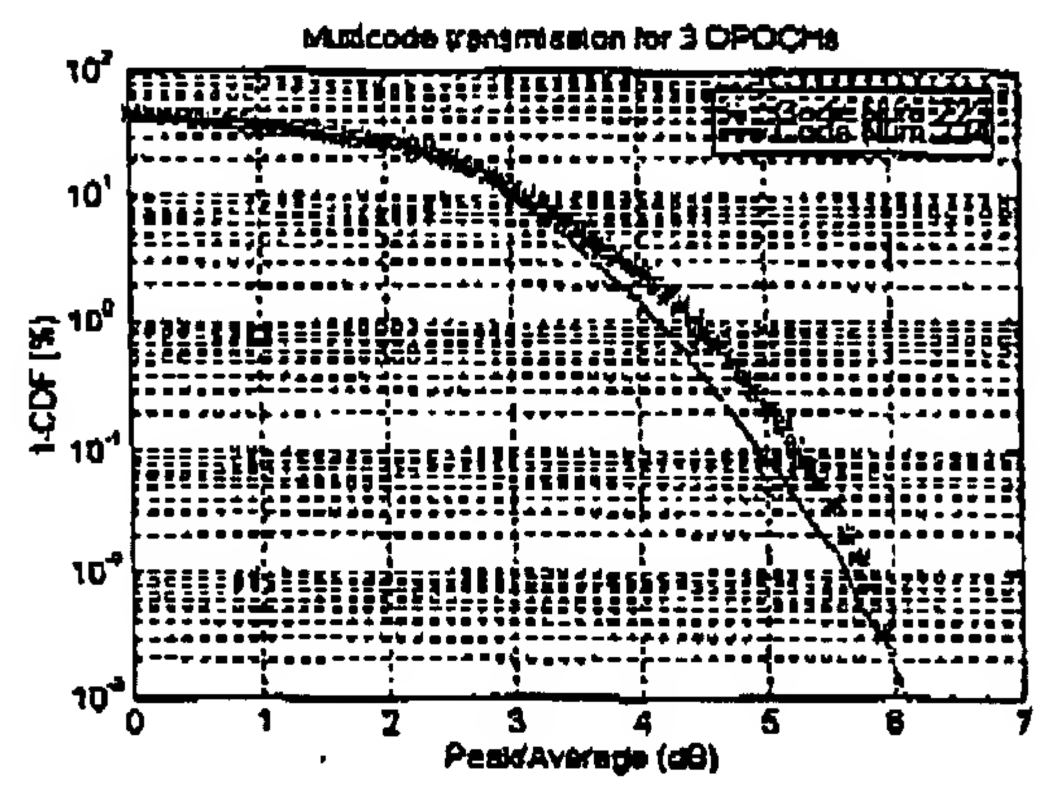

Figure 6. Multicode Transmission for 3 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

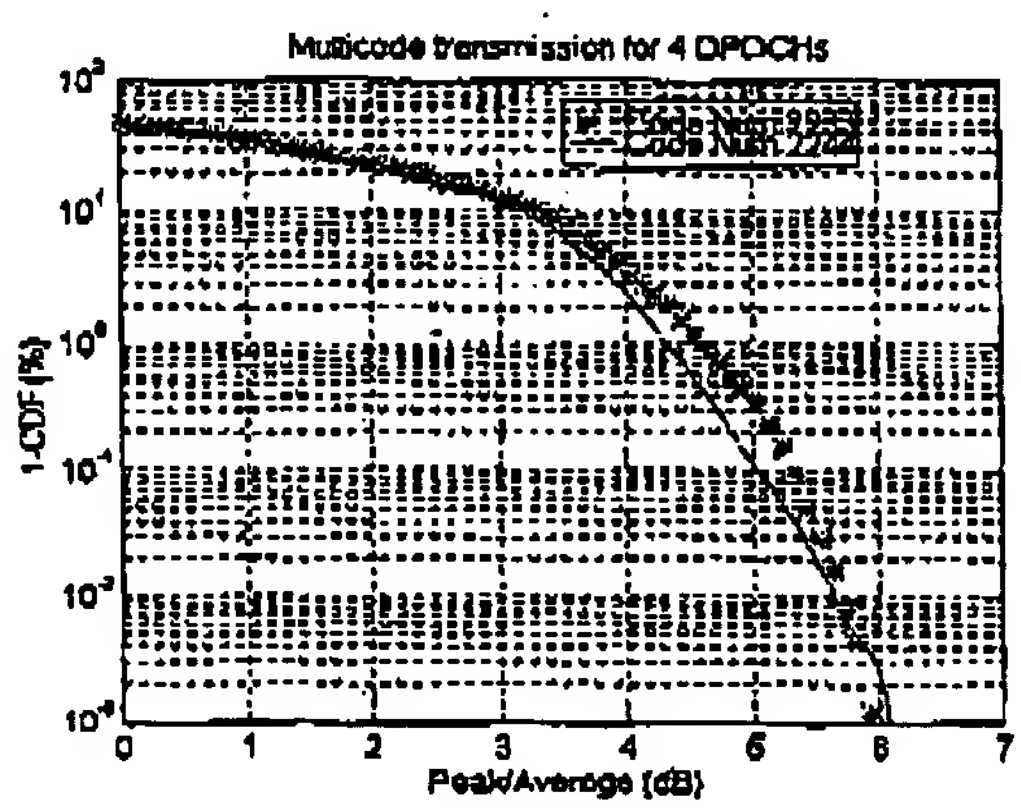

Figure 7. Multicode Transmission for 4 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

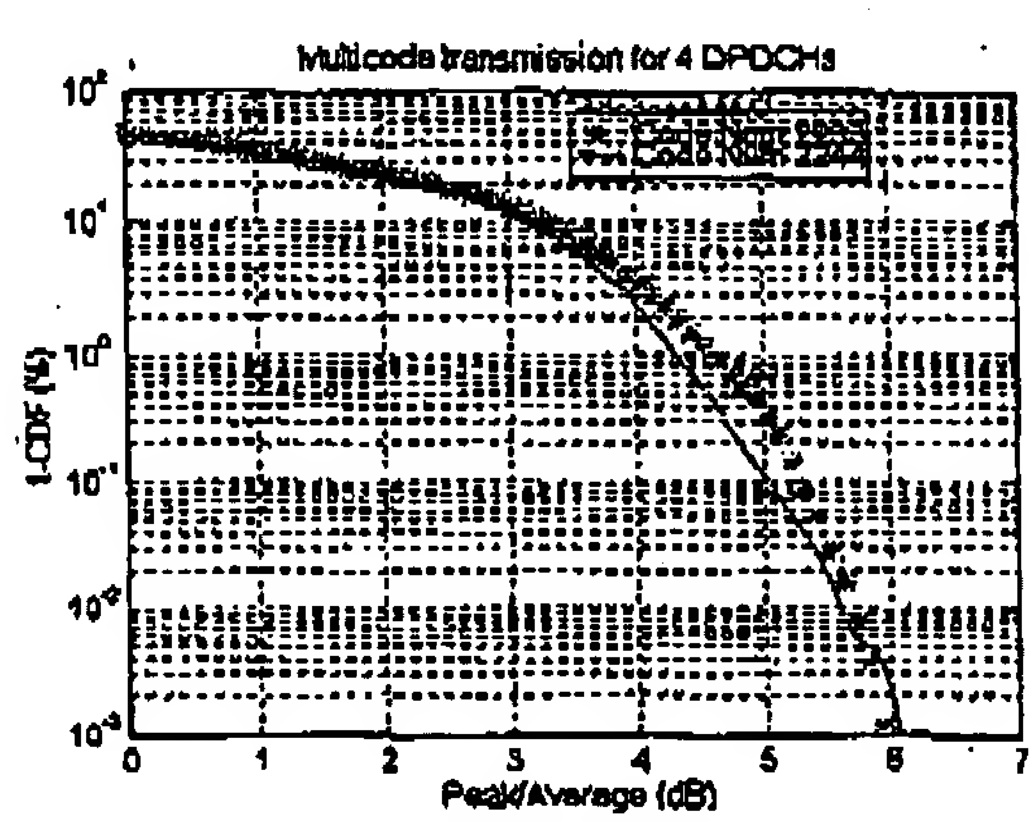

Figure 8. Multicode Transmission for 4 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

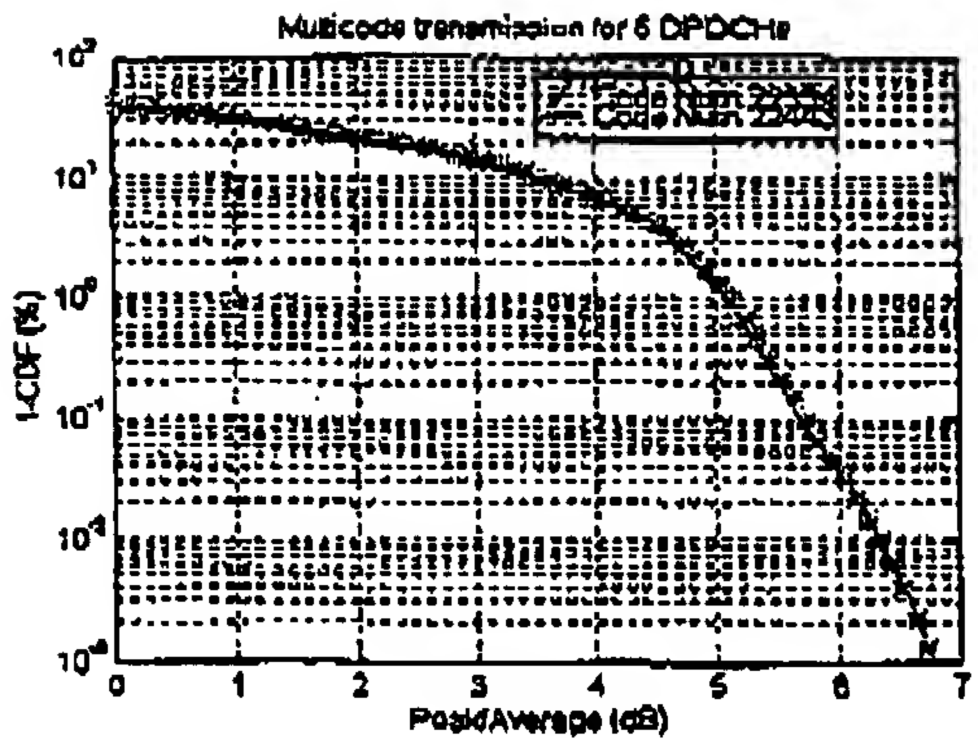

Figure 9. Multicode Transmission for 5 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

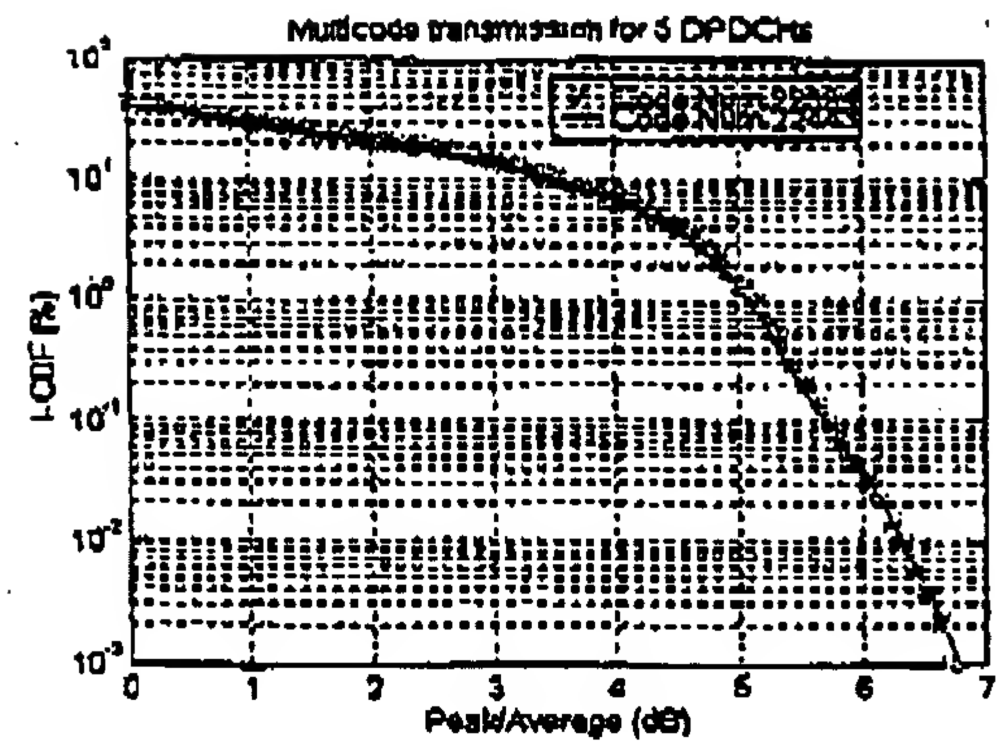

Figure 10. Multicode Transmission for 5 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

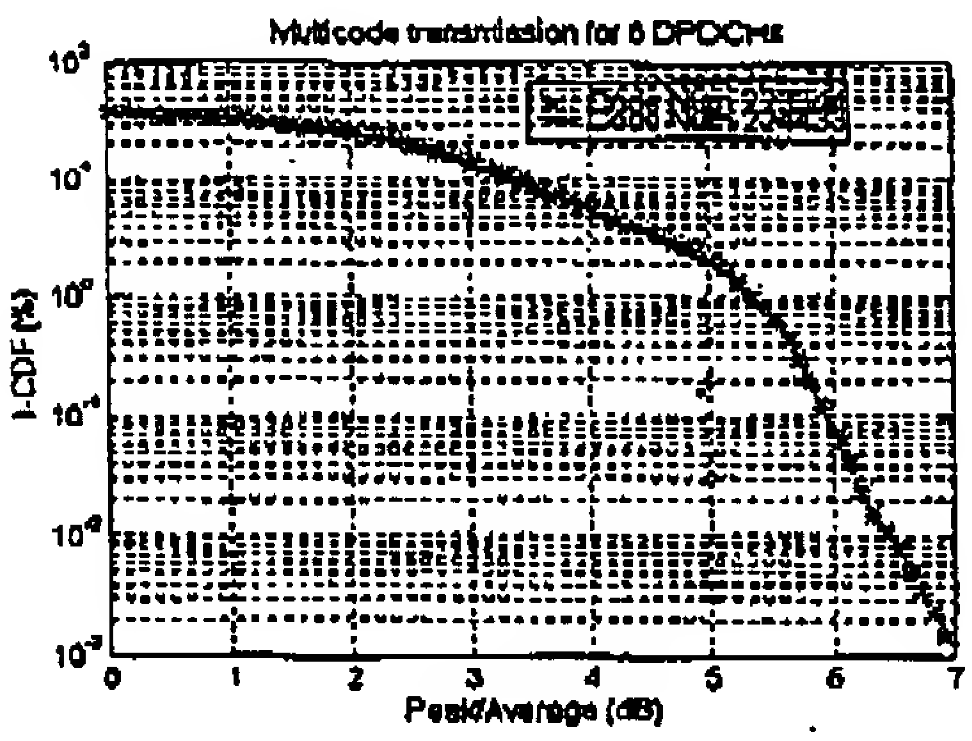

Figure 11. Multicode Transmission for 6 Ch. DPDCHs
(DPDCHs = 21dB, DPCCH = 0dB)

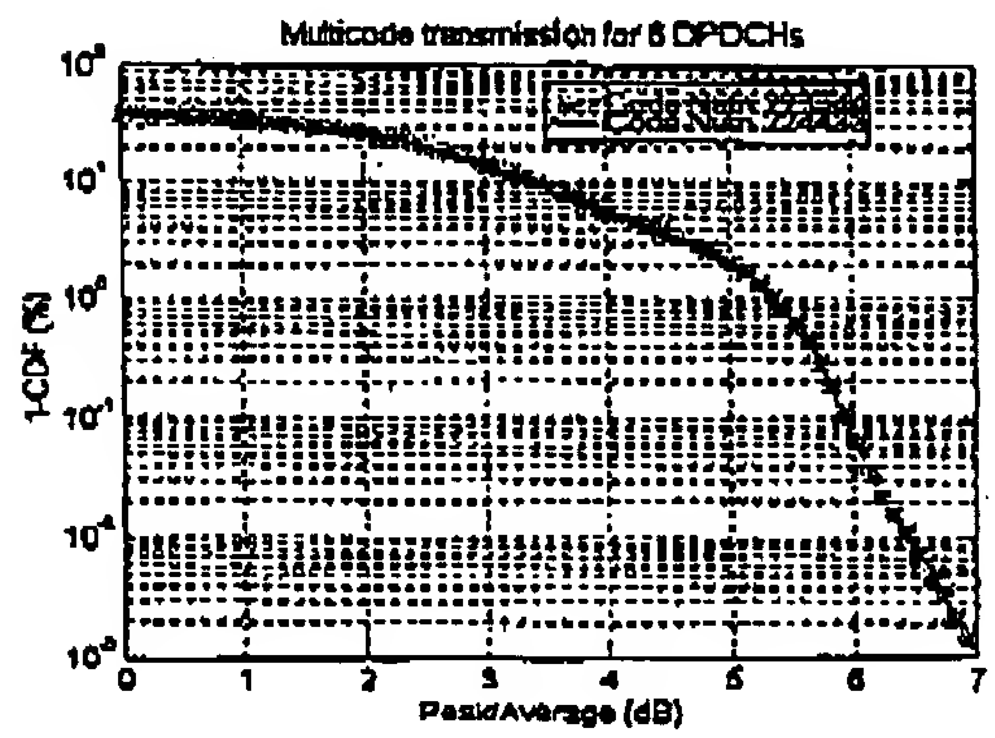

Figure 12. Multicode Transmission for 6 Ch. DPDCHs
(DPDCHs = 24dB, DPCCH = 0dB)

Figures 9 to 12 are the results of 5 and 6 channels of DPDCH. These results show almost the same performance regardless of OVSF code allocation order.

For multicode transmission of DPDCHs with spreading factor of 4, the best channelization code allocation in uplink is to spread with the same code $C_{4,2}$ in case of 2 DPDCHs, and for 3 and 4 DPDCHs the best way is to spread the $DPDCH_3$ and $DPDCH_4$ by code $C_{4,4}$.

3 Conclusion

From the simulation results of PAPR, we propose the k order for code allocation as follows:

- When more than one DPDCH whit spreading factor of 4 are to be transmitted in uplink, $DPDCH_n$ is spread by the code $C_{4,k}$, where $k = 2$ if $n \in \{1, 2\}$, $k = 4$ if $n \in \{3, 4\}$, and $k = 3$ if $n \in \{5, 6\}$.

Reference

[1] TS25.213 v2.1.0(1999-4), "Spreading and modulation"

[2] Ericsson, "Uplink channelization code allocation in UTRA/FDD", TSGR#6(99)845,Espoo, Finland, July 13-16,1999

4.3.1.2 Code allocation for DPCCH/DPDCH/HS-DPCCH

For the DPCCH, DPDCHs and HS-DPCCH the following applies:

- The DPCCH is always spread by code $c_c = C_{ch,256,0}$.
- The HS-DPCCH is spread by code C_{ch} written in table 1A.

Table 1A: channelization code of HS-DPCCH

Nmax-dpdch (as defined in subclause 4.2.1)	Channelization code C_{ch}
1	$C_{ch,256,64}$
2,4,6	$C_{ch,256,1}$
3,5	$C_{ch,256,32}$

- When only one DPDCH is to be transmitted, $DPDCH_1$ is spread by code $c_{d,1} = C_{ch,SF,k}$ where SF is the spreading factor of $DPDCH_1$ and k= SF / 4.
- When more than one DPDCH is to be transmitted, all DPDCHs have spreading factors equal to 4. $DPDCH_n$ is spread by the the code $c_{d,n} = C_{ch,4,k}$, where $k = 1$ if $n \in \{1, 2\}$, $k = 3$ if $n \in \{3, 4\}$, and $k = 2$ if $n \in \{5, 6\}$.

If a power control preamble is used to initialise a DCH, the channelisation code for the DPCCH during the power control preamble shall be the same as that to be used afterwards.

4.3.1.3 Code allocation for PRACH message part

The preamble signature s, $0 \le s \le 15$, points to one of the 16 nodes in the code-tree that corresponds to channelisation codes of length 16. The sub-tree below the specified node is used for spreading of the message part. The control part is spread with the channelisation code c_c (as shown in section 4.2.2.2) of spreading factor 256 in the lowest branch of the sub-tree, i.e. $c_c = C_{ch,256,m}$ where $m = 16 \times s + 15$. The data part uses any of the channelisation codes from spreading factor 32 to 256 in the upper-most branch of the sub-tree. To be exact, the data part is spread by channelisation code $c_d = C_{ch,SF,m}$ and SF is the spreading factor used for the data part and $m = SF \times s/16$.

4.3.1.4 Code allocation for PCPCH message part

For the control part and data part the following applies:

- The control part is always spread by code $c_c = C_{ch,256,0}$.
- The data part is spread by code $c_d = C_{ch,SF,k}$ where SF is the spreading factor of the data part and k=SF/4.

The data part may use the code from spreading factor 4 to 256. A UE is allowed to increase SF during the message transmission on a frame by frame basis.

4.3.1.5 Channelisation code for PCPCH power control preamble

The channelisation code for the PCPCH power control preamble is the same as that used for the control part of the message part, as described in section 4.3.1.4 above.

4.3.2 Scrambling codes

4.3.2.1 General

All uplink physical channels are subjected to scrambling with a complex-valued scrambling code. The DPCCH/DPDCH/HS-DPCCH may be scrambled by either long or short scrambling codes, defined in section 4.3.2.4. The PRACH message part is scrambled with a long scrambling code, defined in section 4.3.2.5. Also the PCPCH message part is scrambled with a long scrambling code, defined in section 4.3.2.6.

There are 2^{24} long and 2^{24} short uplink scrambling codes. Uplink scrambling codes are assigned by higher layers.